LIQUID-MAGMATIC PYRRHOTITE FROM SZARVASKŐ

(With 9 plates).

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The textbook »Geochemistry« of *E. Szádeczky*, member of the Hungarian Academy of Sciences, contains on page 247 in the chapter dealing with the geochemistry of nickel the following passage: »According to upto data in the grabbroic mass of the Bükk Mountain Range there occur surprisingly small amounts of nickel.« My paper furnishes an answer to this very true remark giving fresh data concerning the geochemistry of this — from the petrographic point of view — most interesting district of Hungary.

On the western fringe of the Bükk Mountain Range in the environment of the village of Szarvaskő the considerable subvulcanic gabbromagma mass breaking through as a consequence of the movements caused by the formation of the Alps lifted up clay-slate, sandstone and limestone layers from the middle trias. The gabbromagma is strongly differenciated and partly owing to this and to a lesser extent to fusions, extremely varying rockslirs formed. The wehrlite of the Vasbányahegy of Szarvaskő a peridotite containing an exceptionally large amount of ore is well known as an ultrabasic differential product.

It is also known through the investigations of *F. Papp*[2] and *G. Kisvarsányi*[3] that in the oxide ores of wherlite—ilmenite and magnetite—sulphide ores (pyrrhotite and chalcopyrite) occur in traces, according to the above authors »nearly without exception an inclusions«.

In autumn 1954 North-East of the Vasbányahegy at a distance of not quite one kilometer at the Forgalmi mine pyrrhotite and chalcopyrite occurred in an unusual manner in larger amounts. The fragments were collected by I. Mihâltz.

At the two borders of the mine which is reported by *Zs. Szentpétery*[4] to be classic example of differentiation the magmatite is bounded by contact rocks containing considerable amounts of garnet. In the immediate vicinity of this contact rock the biotitic quartz diorite sample containing a surprisingly large amount of sulphide ores, which separated liquid magmatically from the ultrabasic magma mass was found.

The rock sample weighing originally two kilos contains in addition to the quartz diorite also garnet contact rock. Pyrrhotite occurs in the quartz diorite in patches and veins and the chalcopyrite in it can also be detected with the naked eye. In certain places small droplets of oxide ores can be found. The ore is quite irregularly distributed composing about 25 per cent of the mass of the rock sample. It can also be detected with the naked eye

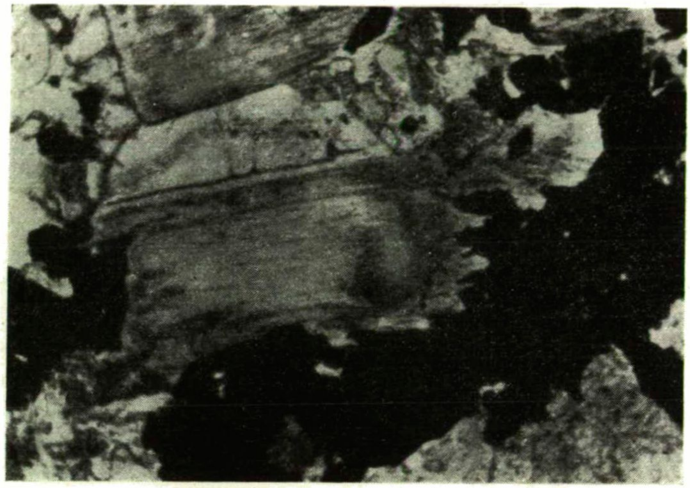

Fig. 1. *Biotite bordered by pyrrhotite* N // × 105

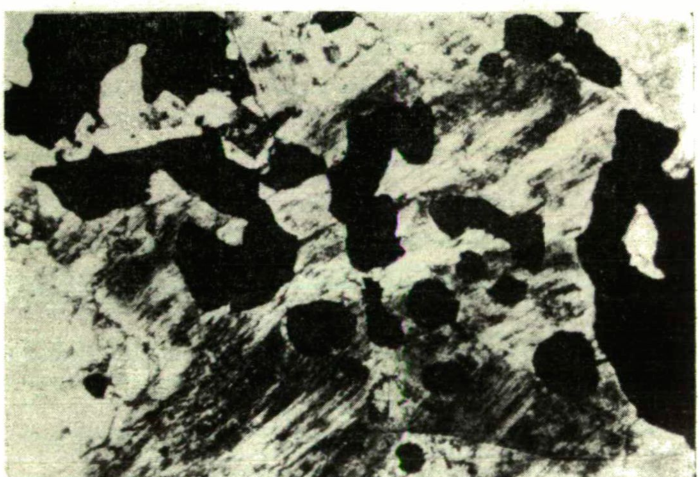

Fig. 2. *Pyrrhotite in biotite* N // × 55

that the larger pyrrhotite patches are situated in the interstices of the rock forming silicates, what more, some larger biotite plates are »framed« by pyrrhotite. In the silicates smaller pyrrhotite and chalcopyrite granules occur frequently as inclusions (Fig. 1 and 2). The rounded granules of the oxide ores can always be found as inclusions in the larger biotite plates (Fig. 3).

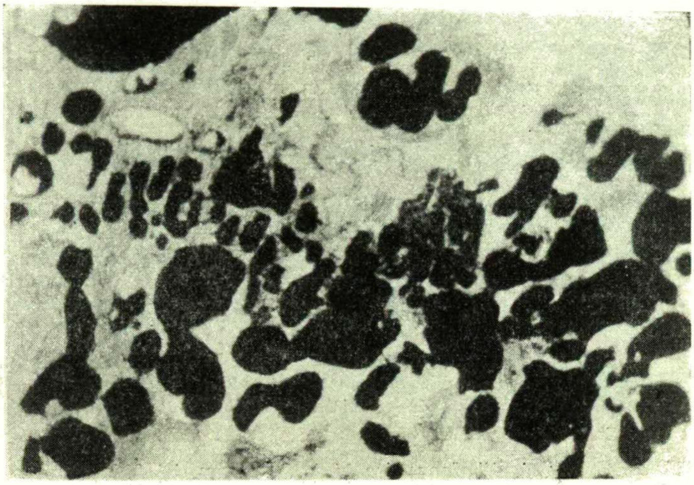

Fig. 3. *Titanomagnetite in biotite and feldspar.* N // × 55

The idiomorphous biotite plates show great folds, the oligoclas feldspar always occuring as polisynthetic twins often shows a zonal structure. The allotriomorphous quartz contains very many small liquid inclusions. The many sillimannites, pointing to the nearness of the contact, is striking.

Of the sulphide ores contained in the rocks pyrite of the first generation is the oldest. Its originally idiomorphous crystals are badly corroded, sometimes only quite rounded granules can be found as inclusions in the pyrrhotite. Besides this primary pyrite this mineral also occur secondarily, it can be found along the lithoclases as a coating. This pyrite is undoubtedly secondary it formed from the pyrrhotite. The amount of primary pyrite is considerably less than that of pyrrhotite and also even than that of chalcopyrite.

The chalcopyrite is an ore occuring relatively extensively. Its tiny crystal 10—25 microns in size embedded in light silicates are idiomorphous showing a granular structure and filling up the interstices of the silicates. The crystallizing silicates in the first place the lathlike plagioclas crystals grew into the ore when it was still plastic (Fig. 4). They are often surrounded by pyrrhotite (Fig. 5). The chalcopyrite granules frequently contain silicate mineral inclusions. If the two ores occur beside each other the inclusions are always contained in the chalcopyrite and not in the pyrrhotite (Fig. 6).

Among the sulphides pyrrhotite is overwhelmingly dominant. Its small idiomorphous crystals, a few microns in size, are surrounded by light rock formations, its granular grains show a platelike structure. On one of the pyrrhotite granules a peculiar twin laminae structure could be observed

Fig. 4. *Chalcopyrite N // Oel imm.* × *330*

Fig. 5. ***Pyrrhotite and chalcopyrite.*** *N //* × *120*

(Fig. 7). The light fine spindle pyrrhotite variations situated parallel to the basic plane are well visible.

The pyrrhotite contains along its cleavage planes beside the fissures many pentlandite flames (Fig. 8) and bunches composed by several flames can also be observed. Pentlandite can always be found beside a cleavage or fissure, it contains small fissures taking an irregular course (Fig. 9). The author is under the impression that pentlandite is not a product of dis-mixture, but that its formation from pyrrhotite is due to the effect of the solutions leaking ultimately in along the fissures.

The pyrrhotite contains pyrite and chalcopyrite inclusions, where as smaller pyrrhotite droplets can sometimes be found as inclusions in the

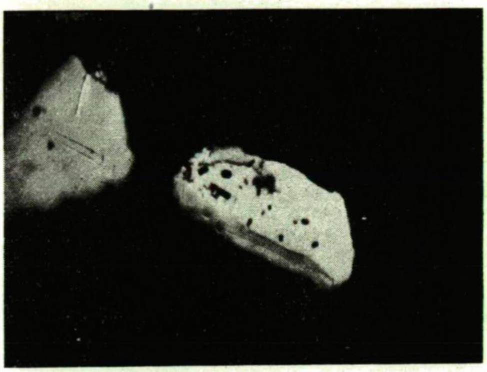

Fig. 6. *Crystal inclusions in chalcopyrite. Oel imm. // $\times$ 330*

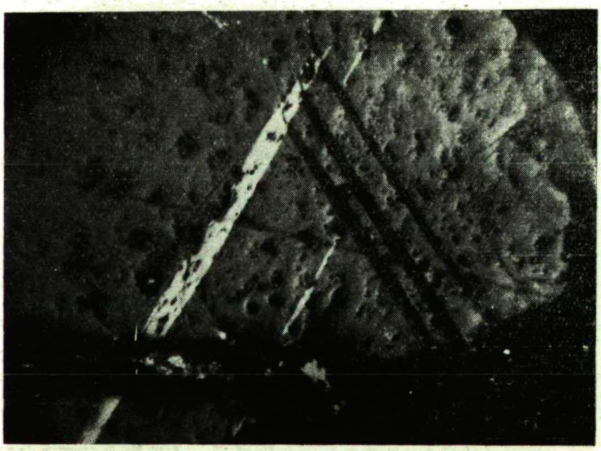

Fig. 7. *Twin-lamellae of pyrrhotite. N + (85°) Oel imm. $\times$ 190*

chalcopyrite. Sometimes small rounded magnetite granules could also be detected as inclusion in the pyrrhotite.

Beside the sulphide ores, but in far smaller amounts, oxide ores also occ-ured mostly magnetite. The small magnetite crystals contained in the light rock formations are idiomorphous, in the biotite the idiomorphous crystals underwent strong resorption, their edges are toothed, around the ore granule the biotite — at the expense of the substance of the ore — shows a far darker colour than that situated further away. The crystallized oxide ores suffered strong resorption in the course of the fusion of the silicates and are generally rounded. Their granules occasionally contain pyrrhotite droplets and still more rarely strongly corroded pyrite inclusions.

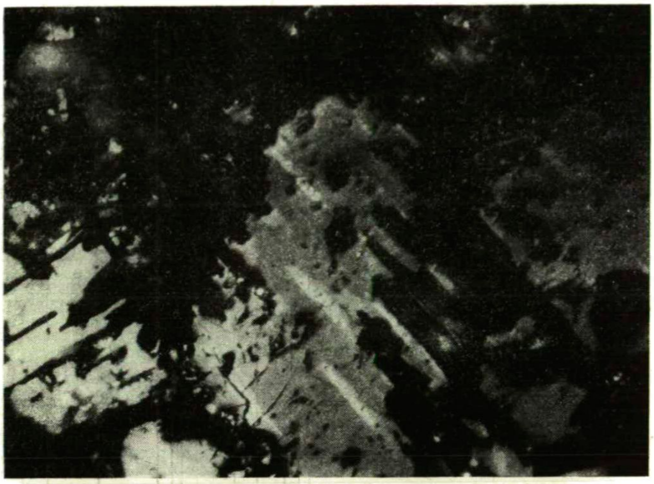

Fig. 8. *Pentlanditer »flames« in pyrrhotite. N + (80°) Oel imm. × 220*

Fig. 9. *Pentlandite »flames« in pyrrhotite. N + (80°) Oel. imm. × 220*

Of the substances only the ore (i. e. the part dissolved in a mixture of hydrochloric and nitric acid and decomposed by fusion with potassium pyrosulphate, respectively) was analysed by *Gy. Grasselly*. The result of the analyses is as follows:

Fe	12.38 per cent
Cu	1.06
Ni	0.67
Co	strong traces
Mn	0.53
S	8.65
TiO_2	0.59
FeO	0.66
Fe_2O_3	0.28

The rocks contain a total amount of 24.82 per cent sulphide and oxide ore, of this 23.29 per cent is sulphide and 1.53 per cent oxide ore.

Spectrographically *Mrs. Földvári* demonstrated strong traces of nickel and cobalt and hardly detectable ones of platinum.

Calculating the amount of sulphide ore for 100 per cent the ore contains 2.87 per cent nickel and more than 4.5 per cent copper, this is a very considerable amount corresponding to the appreciable amount of pentlandite flames which can be detected under the microscope and the chalcopyrite detectable with the naked eye.

Consequently, sulphide ore also separated liquid magmatically from the gabbro-mass and slight traces of this mobile ore magma migrated, owing to the underwent pressure, at the boundary of the magma and contact rock into the most sour, thus ultimately separated crystallized substance. It seems worth while to investigate where the larger liquid-magmatically separated sulphide ore masses are concealed as their considerable nickel and copper content makes this worthy of further investigations.

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